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COMPLETE SPECIFICATION.

Improvements in and relating to Electric Capacitors.

We, PHOTO PRINTED CIRCUITS LIMITED, a British Company, of Guildford Road, Bisley, Surrey, do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

The present invention relates to electric capacitors.

One object of the present invention is to provide an improved electric capacitor which can be made by a method including a photo-printing or other printing step and which can have a larger capacitance for a given size of construction than known capacitors produced by printing methods.

According to the present invention an electric capacitor comprises two spaced electrodes of metal foil affixed in coplanar relationship to an insulating support, each electrode having a plurality of fingers, the fingers of one electrode lying in the spaces between the fingers of the other electrode, and dielectric material of a permittivity exceeding that of air filling at least part of the channel between the fingers of the two electrodes. In a preferred arrangement the said dielectric material in addition to filling the channel between the two electrodes extends over the electrodes.

The invention will now be described by way of example with reference to the accompanying drawings in which:—

Fig. 1 is a plan to an enlarged scale of a capacitor according to the invention;

Fig. 2 is a cross-section taken at 2—2 in Fig. 1; and

Fig. 3 is a cross-section of a further capacitor according to the invention.

The capacitor shown in Fig. 1 comprises an insulating support 10 of material such as a sheet of resin bonded laminated paper. Bonded to the support 10 are two electrodes 11 and 12 of copper foil a few thousandths of an inch in thickness. Each of the electrodes has a plurality of fingers such as the finger 13 on the electrode 11 and the finger 14 on the electrode 12. As will be seen in the drawing the fingers of one of the electrodes lie in the spaces between the fingers of the other electrode and are spaced therefrom.

Referring now to Fig. 2, this is a cross-section taken at 2—2 of Fig. 1 with the thickness of the copper foil exaggerated for clarity in the drawing, and it will be seen that the channel 15 between the two electrodes is filled. The filling is of dielectric material of a permittivity exceeding that of air and may take any of several different forms. It may be an adhesive substance of high permittivity applied in the form of a solution, a suspension or dry powder and subsequently heated to dry the solution or suspension or to melt the powder. Alternatively the dielectric material may be applied in the form of an intimate mixture of a powdered material of high permittivity such as alumina or a ceramic with a powdered or liquid adhesive such as powdered shellac or a shellac solution respectively, the adhesive serving as a binder for the high permittivity material as well as retaining the dielectric material in the channel.

Referring now to Fig. 3, this is a cross-section of another embodiment of the invention in which the dielectric material covers the electrodes 11 and 12 in addition to filling the channel between the electrodes, the dielectric material covering the two electrodes being shown at 16. The layer 16 prevents contact of the electrodes with the atmosphere and the corrosion that would

result therefrom when the electrodes are of a metal such as copper.

The dielectric material may be applied in various ways, for example, by dipping, spraying, brushing or screen printing. To prevent bubbles of air from being trapped in the dielectric material it may be applied under vacuum, for example, by spraying. In the case of a construction as shown in Fig. 2 the excess dielectric material can be removed for example by means of a squeegee. Although Fig. 2 shows the channel between two electrodes completely filled it will be appreciated that the channel need be only filled for part of its depth in some instances or it may be filled along only a part of its length depending upon the value of capacitance required.

The electrodes having the shape shown in Fig. 1 may be produced in any suitable manner. In a preferred method the insulator 10 has a continuous sheet of copper foil bonded thereto. The exposed face of the foil is coated with an etching resist which is dried. The dry coating is treated with a suitable chemical to render the coating light sensitive and the coating so treated is exposed to light directed on to the coating through a photographic negative of the pattern shown in Fig. 1. Thus the exposed parts of the coating are hardened enabling the unexposed parts to be removed with water. The exposed copper foil is then etched away and finally the resist coating is removed. By means of such a process it is possible to produce electrodes in which the width of each finger is no more than seven thousandths of an inch and the width of the channel is the same. Thus a capacitor in accordance with the invention occupying an inch square can have a capacitance of up to 3,000 micro-microfarads dependent upon the permitivity of the dielectric filling.

WHAT WE CLAIM IS:—

1. An electric capacitor comprising two spaced electrodes of metal foil affixed in coplanar relationship to an insulating support, each electrode having a plurality of fingers, the fingers of one electrode lying in the spaces between the fingers of the other electrode and dielectric material of a permittivity exceeding that of air filling at least part of the channel between the fingers of the electrodes.

2. An electric capacitor according to Claim 1, wherein the said dielectric material fills the said channel completely.

3. An electric capacitor according to Claim 1, wherein the said dielectric material fills the said channel and extends over the said electrodes.

4. An electric capacitor substantially as hereinbefore described with reference to Figs. 1 and 2 of the accompanying drawings.

5. An electric capacitor substantially as hereinbefore described with reference to Figs. 1 and 3 of the accompanying drawings.

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PROVISIONAL SPECIFICATION.

Improvements in and relating to Electric Capacitors.

We, PHOTO PRINTED CIRCUITS LIMITED, a British Company, of Guildford Road, Bisley, Surrey, do hereby declare this invention to be described in the following statement:—

The present invention is concerned with improvements in and relating to capacitors and to methods of making capacitors.

One object of the present invention is to provide a capacitor which can be made by a method including a photo-printing or other printing process and which can have a comparatively wide range of values of capacitance.

Another object it to provide a method including a photo-printing or other printing process of making capacitors, which capacitors can have a comparatively wide range of values of capacitance.

According to the present invention there is provided a capacitor comprising a support of an insulating material, a pair of spaced conductive electrodes mounted on the support, and a dielectric material in the space between the two conductive electrodes.

Also according to the present invention there is provided a method of making a capacitor comprising the steps of producing by a photo-printing or other printing process two spaced conductive electrodes mounted on a support of insulating material, and applying a dielectric material to the space between the edges of the two conductive electrodes.

The dielectric material may comprise an intimate mixture of a material of high permittivity in powder form and a binding material in liquid or powder form. The two spaced conductive electrodes may comprise two metallic films of comb-like shape and lying in the same plane, the teeth of the two films interlacing with each other to provide

a space in the plane of the films, and in such a capacitor the dielectric material may fill the said space and extend over at least part of one or both of the metallic film electrodes.

Capacitors in accordance with the invention and methods in accordance with the invention of making such capacitors will now be described, by way of example.

A support of insulating material having two spaced conductive electrodes on one surface thereof may be produced, for example, by a photo-printing process as follows. A thin plane sheet of an insulating material, e.g. bakelite, has a thin plane sheet of a metal of good conductivity, e.g. copper, fixed to one face thereof. The exposed surfaces of the copper sheet are coated with a liquid that, when dry and hardened, will resist the action of an etching fluid. The resist coating is made sensitive to light and is then exposed through a negative, exposure of the coating to light causing the exposed parts to harden. The unexposed parts of the coating are washed away and the parts of the copper sheet thus revealed are removed by the action of an etching fluid. On completion of the etching operation the exposed parts of the resist coating are removed.

The pair of spaced conductive electrodes which result comprise two metallic films of comb-like shape and lying in the same plane, the teeth of the two films interlacing with one another to provided between the two films a space which lies in the same plane as the two films. We have found it possible to produce such electrodes by a printing process with which the width of each tooth is seven thousandths of an inch, and the width of the space between the adjacent edges of two immediately adjacent teeth is also seven thousandths of an inch. Such a construction can be used as an air-dielectric capacitor.

A capacitor in accordance with he invention is produced from such a construction by applying to the space between the two electrodes a dielectric material having a dielectric constant substantially higher than that of air. The capacitance of the capacitor will depend, among other factors, on the amount of dielectric material in the space and the space may be only partly filled with the dielectric material, or the material may completely fill the space and extend over at least part of one or both of the metallic film electrodes.

The dielectric material may comprise an adhesive in a form in which it will flow readily into the space, e.g. a solution or a suspension or a fine powder, the adhesive which enters the space being retained therein by heating to dry the suspension or solution or to melt the powder. Alternatively the dielectric material may comprise an intimate mixture of a powdered material of high permittivity, such as alumina or a high permittivity ceramic with a powdered or liquid adhesive, such as powdered shellac or a shellac solution respectively, the adhesive serving both to bind the particles of dielectric material together and to retain the dielectric material in the space between the electrodes. The dielectric material may be applied to the support, for example, by dipping, spraying, brushing or screen printing and preferably it extends over both the conductive electrodes, thereby preventing contact of the atmosphere with the electrodes and the corrosion which may result from such contact. The dielectric material may be applied while the support is in a vacuum, e.g. by spraying from a nozzle, to prevent the trapping of bubbles of air in the resulting dielectric layer.

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Fig. 1.

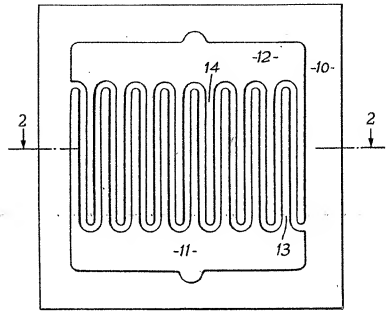

Fig. 2.

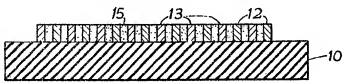

Fig. 3.